



Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

August 19, 2016

10 CFR 50.73

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2
Facility Operating License No. NPF-96
NRC Docket No. 50-391

Subject: **Licensee Event Report 391/2016-005-00, Main Feedwater Pump Trip on
Loss of Condenser Vacuum Leads to Turbine Trip and Reactor Trip**

This submittal provides Licensee Event Report (LER) 391/2016-005-00. This LER provides details concerning a recent event where the operating main feedwater pump turbine lost condenser vacuum, resulting in a turbine trip and subsequent reactor trip. This report is being submitted in accordance with 10 CFR 50.73(a)(2)(iv)(A).

Please direct any questions concerning this matter to Gordon Arent, WBN Licensing Director, at (423) 365-2004.

Respectfully,

A handwritten signature in black ink, appearing to read "Paul Simmons", is written over a horizontal line.

Paul Simmons
Site Vice President
Watts Bar Nuclear Plant

Enclosure
cc: See Page 2

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cc (Enclosure):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Watts Bar Nuclear Plant



LICENSEE EVENT REPORT (LER)

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1. FACILITY NAME

Watts Bar Nuclear Plant, Unit 2

2. DOCKET NUMBER

05000391

3. PAGE

1 OF 6

4. TITLE

Main Feedwater Pump Trip on Loss of Condenser Vacuum Leads to Turbine Trip and Reactor Trip

5. EVENT DATE

MONTH	DAY	YEAR
06	20	2016

6. LER NUMBER

YEAR	SEQUENTIAL NUMBER	REV NO.
2016	- 005	- 00

7. REPORT DATE

MONTH	DAY	YEAR
08	19	2016

8. OTHER FACILITIES INVOLVED

FACILITY NAME	DOCKET NUMBER
N/A	N/A
N/A	N/A

9. OPERATING MODE

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

1

<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)
<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)
<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)
<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)

10. POWER LEVEL

32

<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)
<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)
<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.77(a)(1)
<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(2)(i)
<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 73.77(a)(2)(ii)
	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> OTHER	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT

Dean Baker, Licensing Engineer

TELEPHONE NUMBER (Include Area Code)

423-452-4589

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE) ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On June 20, 2016, the 2B Main Feedwater Pump (MFP) tripped on a loss of vacuum in the 2B MFP turbine condenser, resulting in a loss of normal feed, and the subsequent trip of the main turbine. While operators were reducing power to within the capacity of Auxiliary Feedwater (AFW), the reactor tripped at 1540 Eastern Daylight Time (EDT) on Steam Generator Water Level (SGWL) Lo Lo in Steam Generator No.4. SG water level lowered rapidly due to shrink from the relatively cold AFW following the trip.

All control and shutdown rods fully inserted. All safety systems responded as designed. The trip response was uncomplicated.

The trip was caused by a human performance error during the drain down of the 2A MFP turbine condenser which resulted in a loss of vacuum on the 2B MFP turbine.

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(11-2015)

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APPROVED BY OMB: NO. 3150-0104

EXPIRES: 10/31/2018



LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Watts Bar Nuclear Plant, Unit 2	05000391	2016	- 005	- 00

NARRATIVE

I. PLANT OPERATING CONDITIONS BEFORE THE EVENT

Watts Bar Nuclear Plant (WBN) Unit 2 was in Mode 1 at 32 percent Rated Thermal Power (RTP).

II. DESCRIPTION OF EVENT

A. Event

On June 20, 2016, the 2B Main Feedwater Pump (MFP) {EIS:P} tripped on a loss of vacuum in the 2B MFP turbine condenser, resulting in a loss of normal feed {EIS:SJ}, and the subsequent trip of the main turbine. While operators were reducing power to within the capacity of Auxiliary Feedwater (AFW) {EIS:BA}, the reactor tripped at 1540 Eastern Daylight Time (EDT) on Steam Generator Water Level (SGWL) Lo Lo in Steam Generator No.4. SG water level lowered rapidly due to shrink from the relatively cold AFW following the trip.

All control and shutdown rods fully inserted. All safety systems responded as designed. The trip response was uncomplicated.

B. Inoperable Structures, Components, or Systems that Contributed to the Event

No inoperable systems contributed to the event.

C. Dates and Approximate Times of Occurrences

Date	Time (EDT)	Event
6/20/16	1500	Auxiliary Unit Operators (AUOs) dispatched to drain the 2A MFP Turbine condenser (MFPTC) in preparation for start up.
6/20/16	1510	AUOs begin draining the 2A MFPTC. Alarm received for MFPTC Vacuum Lo. AUOs directed to stop draining the condenser due to alarm. Based on the expectation to receive the alarm, permission to continue draining was authorized.
6/20/16	1520	AUOs begin draining 2A MFPTC for second time. Concurrently, Instrumentation and Control (I&C) personnel commenced work on an Integrated Computer System (ICS) Data Link Card. This resulted in the Main Control Room (MCR) board recorder used to trend MFPTC vacuum to swap to its post-accident parameter and off of the MFPTC vacuum. AUOs directed by MCR to stop draining 2A MFPTC until card replacement completed. Once the card replacement was complete, the recorder was restored to its normal parameter monitoring state.
6/20/16	1537	Based on MCR direction, AUOs attempt to drain 2A MFPTC for third time. Upon opening drain valve, 2B MFP turbine trips.
6/20/16	1540	Based on the lower flows in Steam Generators (SGs) No.2 and 3 and the fact that the Trip Time Delays (TTDs) for those same S/Gs were started, operators took manual control of AFW flow and reduced the flow to the No. 1 and 4 SGs so that all 4 flows were balanced. All SGWLs were still lowering slowly based on the shrink of the water in the SGs. SGWLs stopped dropping and started to turn. Around this

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Date	Time (EDT)	Event
		time, rods had been inserted enough that power was nearing the capabilities of the AFW system. The reactor tripped automatically on No. 4 SG Level Lo-Lo.

D. Manufacturer and Model Number of Components that Failed

There were no equipment failures associated with this event .

E. Other Systems or Secondary Functions Affected

No other safety systems were affected by this event.

F. Method of discovery of each Component or System Failure or Procedural Error

There were no failed components, systems or procedural errors associated with this event.

G. Failure Mode and Effect of Each Failed Component

No component failures were associated with this event .

H. Operator Actions

Following the loss of the 2B MFP, operations personnel attempted to reduce power such that SG levels could be maintained within acceptable levels using the AFW system. They were unsuccessful, and a reactor trip occurred. The subsequent recovery and response to the trip were uncomplicated.

I. Automatically and Manually Initiated Safety System Responses

All safety systems operated as expected.

III. CAUSE OF THE EVENT

A. The cause of each component or system failure or personnel error, if known.

This event was not the result of a component or system failure.

B. The cause(s) and circumstances for each human performance related root cause.

Operations staff did not recognize that, based on the system alignment present shown in Figure 1, that lowering the 2A MFPT condenser below a certain point would cause a loss of vacuum on the 2B MFPT condenser. Additionally, when taking manual control of steam generator water level, the TTDs for steam generator level were already actuated, and operators should have manually tripped the reactor prior to reaching an automatic trip.

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IV. ANALYSIS OF THE EVENT

The MFPT Condensers for the 2A and 2B MFPTs share a common MFPT Condenser Drain Tank. When AUOs drained the 2A MFPT Condenser completely, an air in leakage path was created from the turbine steam seals on the 2A MFPT (steam seals were out of service) through the 2A MFPT Condenser to the MFPT Condenser Drain Tank to the 2B MFPT condenser (see Figure 1). This resulted in a loss of vacuum on the 2B MFPT Condenser and a trip of the 2B MFPT.

Loss of the 2B MFP led to a main turbine trip. Operations attempted to reduce power such that the AFW system could maintain SG level, but were unsuccessful.

V. ASSESSMENT OF SAFETY CONSEQUENCES

The loss of the 2B MFP led to a turbine trip, and subsequent reactor trip on Lo-Lo SG level in the No. 4 SG. At the time of the reactor trip, SG levels were already recovering. All safety systems operated as expected during this event.

- A. Availability of systems or components that could have performed the same function as the components and systems that failed during the event

No safety systems failed during this event.

- B. For events that occurred when the reactor was shut down, availability of systems or components needed to shutdown the reactor and maintain safe shutdown conditions, remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident

Not applicable.

- C. For failure that rendered a train of a safety system inoperable, an estimate of the elapsed time from the discovery of the failure until the train was returned to service

Not applicable.

VI. CORRECTIVE ACTIONS

This event was entered into the Tennessee Valley Authority (TVA) Corrective Action Program and is being tracked under condition reports (CRs) 1183877 and 1186630.

- A. Immediate Corrective Actions

The trip was reviewed and the human performance issues that led to this event were identified and coaching provided.

- B. Corrective Actions to Prevent Recurrence

The event is considered a performance issue for operations to precisely control the plant. Additional training in response to this event will be performed.

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VII. ADDITIONAL INFORMATION

A. Previous similar events at the same plant

No similar events have been identified at the Watts Bar plant .

B. Additional Information

None.

C. Safety System Functional Failure Consideration

This condition did not result in a safety system functional failure.

D. Scrams with Complications Consideration

This reactor trip was determined to be uncomplicated.

VIII. COMMITMENTS

None.

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NARRATIVE

U2 Main Feed Pump Turbine Condenser Drain Schematic

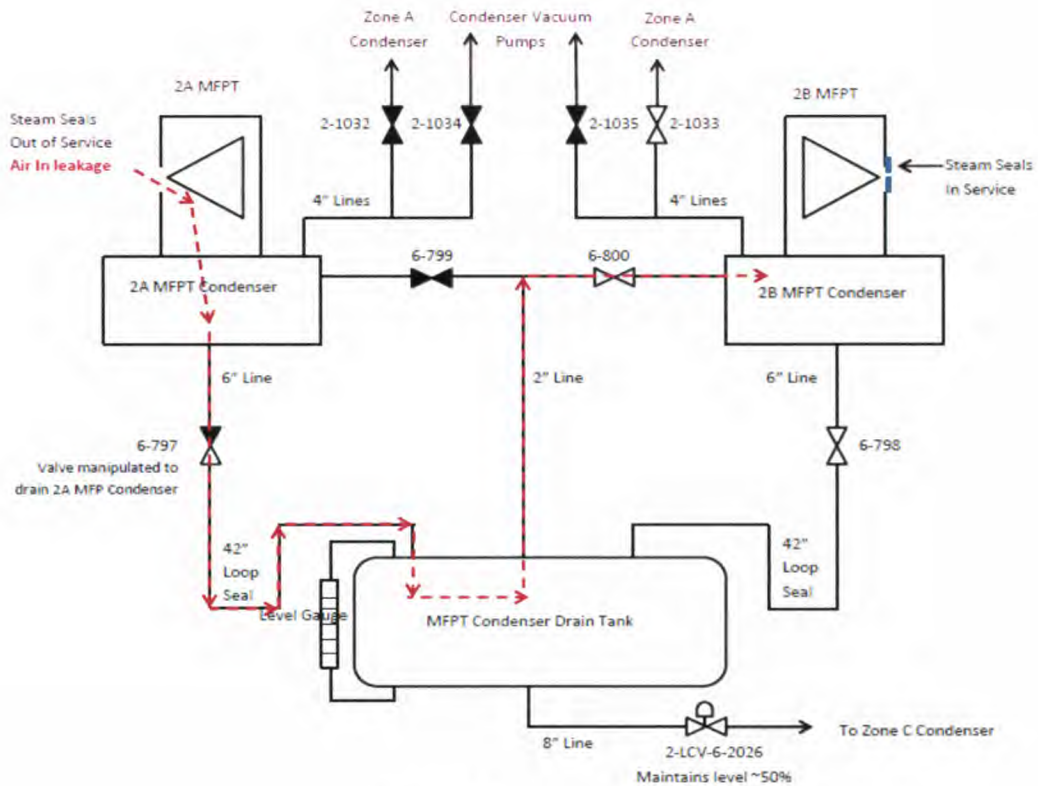


Figure 1